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SHIP BALLAST WATER: AN ALTERNATIVE TREATMENT

The economic and health consequences of bioinvasive species in ballast water is increasing at an exponential rate (Topfer, UNEP, Globallast 8, 2002). Given a probable 20-25 year phase-out of existing vessels, retrofitting of verified treatment systems becomes an option.

Treatment alternatives to ballast water exchange (BWE), have to their advantage: (1) The more "exotic" the source of ballast water, the greater the distance to a recipient ecosystem. (2) While intransit, a closed-loop process with reduced flow rates of ballast water can be utilized, enhancing the effectiveness of physical treatment with a smaller scale of processing equipment.

Processing of ship ballast water with ultraviolet light has focused primarily on the brief period during ballasting or deballasting, where flow volumes and turbidity require large separators and UV reactors that are expensive to install, and to operate.

There is an alternative approach, which is to use the duration of the voyage to cycle contained ballast water, at substantially reduced flow rates and with smaller and less expensive separators and UV reactors. Electrical generation can be more efficiently dedicated to processing intransit, due to the reduced demand for other shipboard operations.

The proposed retrofit, as described here, could incorporate the existing ballast water exchange system, with the potential to supplement, as well as to provide an alternative closed system for continuous processing enroute. This provides the option of at-sea BWE followed by closed-loop UV treatment, alternatively, restricted to a closed-loop UV system when within continental waters.

Ideally, the most effective configuration would be to transfer ballast water from a full tank, via a UV reactor, to an empty tank. The closed-loop system, however, does have the advantage of controlling free-surface within ballast tanks.

Advantages:

- (1) efficiency of installation
- (2) economic operation
- (3) operable with existing electrical generating capacity while under way
- (4) capable of continuous operation
- (5) potential for incorporation of additional units
- (6) potential for secure monitoring and, ultimately, status transmission on demand

Vessels presently carrying ballast water have varying capacities to exchange ballast water enroute. The effectiveness of BWE has yet to be quantified in terms of reduction of nuisance organisms, however the effects of purging can only be in the direction of reducing suspended particulates and sediment accumulation in ballast tanks. By this, the organisms within ballast tanks are exposed to higher dose rates in UV reactors, where most are either killed, rendered sterile, or incapacitated through structural damage by UV.

This would require the reconfiguration of piping to, and between, ballast tanks, specific to individual ship design, to create when in transit, a closed-loop circuit passing through UV reactors (patent pending). Constant speed or variable speed pumps would circulate ballast water, resulting in a series of exposures of organisms to irradiation (dosages that are cumulative). Multiple passes through UV reactors should compensate for the higher levels of particulates in ballast water. The reduced flow rates of ballast water (to 5-10%) during ship transit, could also permit more effective treatment by mechanical separation as well,

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further removing sediment and oil residues. Stagnant regions within ballast tanks can be addressed by retrofitting return piping with an internal manifold: a rack of nozzles, adjusted to the specific tank configuration (patent pending). During at-sea BWE, this same manifold would be used to increase suspension of sediments within ballast tanks.

The advantages of a self-contained treatment system:

- (1) independent of sea state, packice
- (2) independent of ship delays
- (3) independent of onshore work disruption
- (4) sampling prior to deballasting could indicate if extended UV treatment is required

Situations will occur where vessels require emergency deballasting in coastal areas. A closed loop, self-contained UV system with mechanical separation, would provide assurance that deballasted water had been subjected to processing.

The economical approach is to incorporate existing UV technology. Trojan Technologies, of London Ont. (www.trojanuv.com) are certified ISO 9001, building systems for the treatment of drinking water. They have developed the Trojan UVSwift™, a compact UV technology for high volume flow, and validated by third party for UV dose delivery. The reactor is self-cleaning, as well as incorporating a dosimeter, monitoring both instantaneous and cumulative dosage indices. This system is ideally suited for incorporation into a closed loop configuration, and subjected to the process of testing in this additional role.

A Canadian patent has been obtained for the closed-loop UV process, and a worldwide patent application filed.

Paul F. Brodie PhD
Fisheries Oceanography
Halifax, Nova Scotia
Canada
<pbrodie@hfx.eastlink.ca>